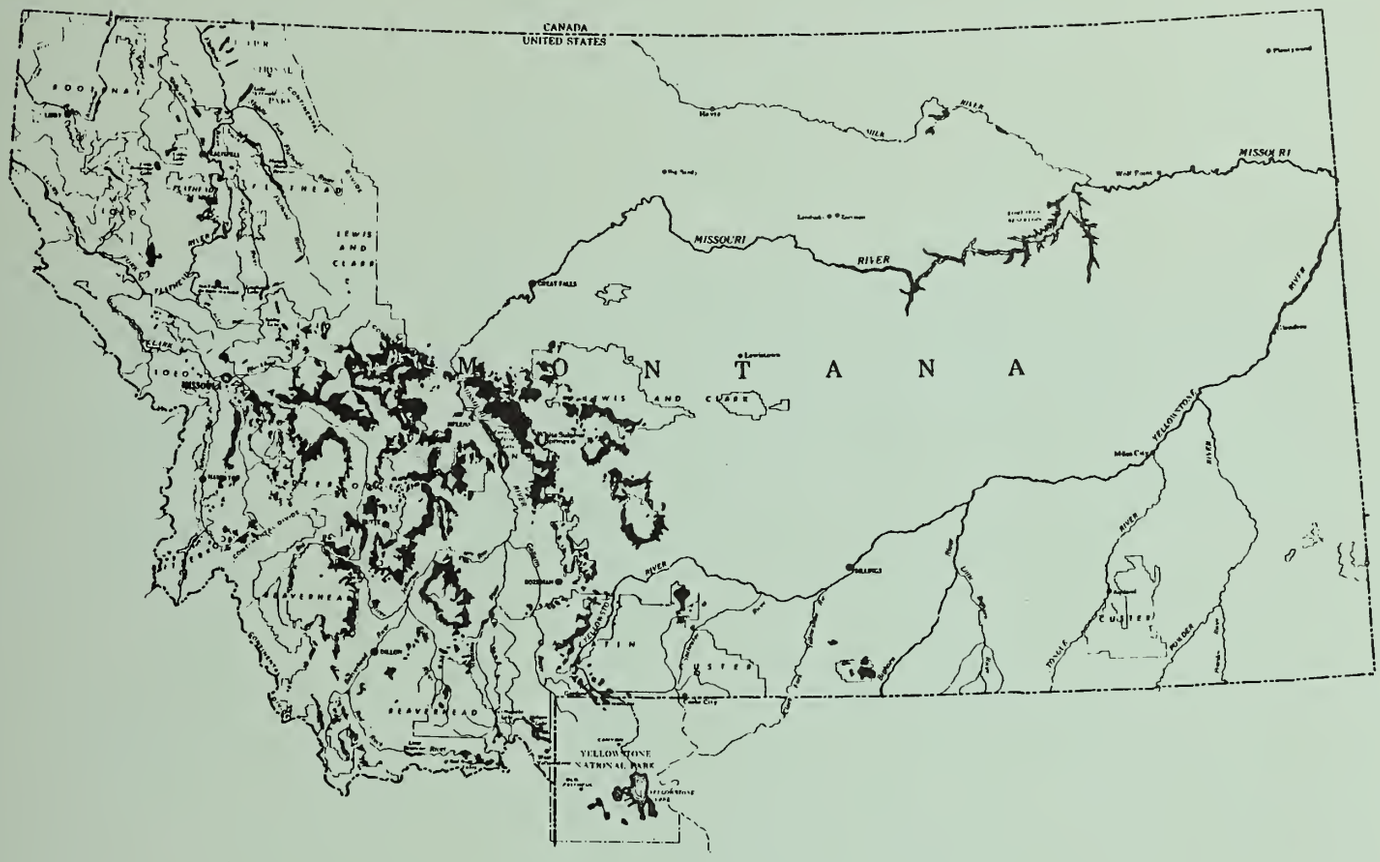
MONTANA



FOREST PEST CONDITIONS AND PROGRAM HIGHLIGHTS

1986

REPORT 87-2

APRIL 1987

USDA
Forest Service
Northern Region

Montana
Dept of State Lands
Forestry Division

Map depicts areas in Montana on which defoliation caused by western spruce budworm was observed in 1986. See page 11.

MONTANA FOREST PEST CONDITIONS AND PROGRAM HIGHLIGHTS

1986

Compiled by:

Kenneth E. Gibson
Susan K. Hagle
Steve Kohler

Report 87-2

April 1987

U.S. Department of Agriculture
Forest Service, Northern Region
Cooperative Forestry & Pest Management
P. O. Box 7669
Missoula, Montana 59807

Montana Department of State Lands
Forestry Division
Forest Insect & Disease Section
2705 Spurgin Road
Missoula, Montana 59801

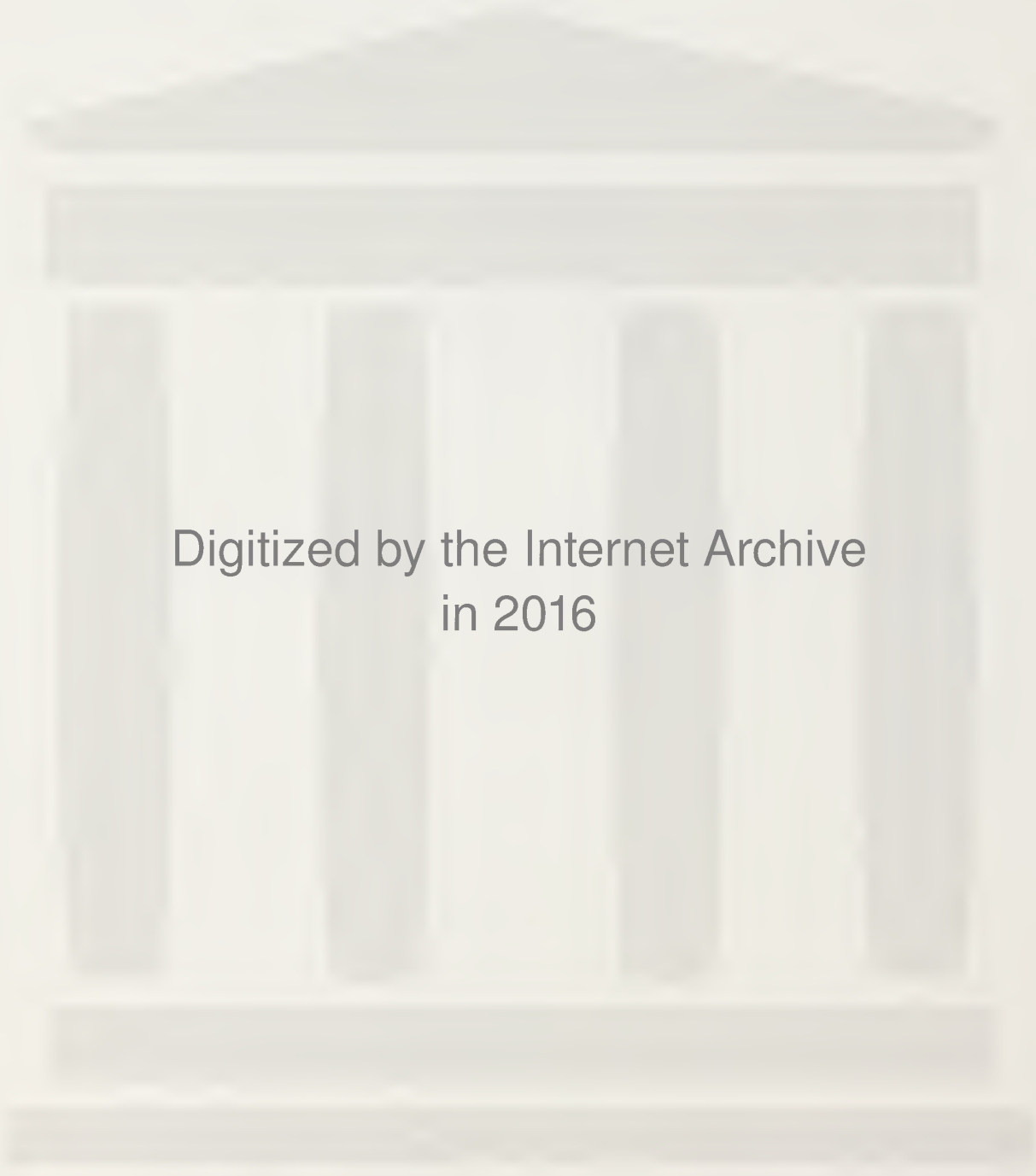


TABLE OF CONTENTS

INTRODUCTION

This report, jointly prepared by USDA Forest Service, Cooperative Forestry and Pest Management, and Montana Department of State Lands, Forestry Division, summarizes results of aerial and ground surveys intended to identify and define forest pest concerns during 1986. Areas of major insect and disease damage on forested lands of all ownerships within the State are identified. Acreage of infested areas, as well as resultant growth loss and mortality, has been estimated. Activities associated with these surveys and damage estimates are also described.

Prior to 1980, a single yearly report of insect and disease conditions in the Northern Region was prepared. Beginning in 1980, separate reports for Montana and Idaho have been prepared each year. A report similar to this one for Idaho for 1986 has been written by USDA Forest Service and Idaho Department of Lands.

SUMMARY OF CONDITIONS

Insects and diseases continuing to cause widespread damage, and often severe economic losses, in Montana's forests in 1986 included mountain pine beetle, western spruce budworm, root diseases, and dwarf mistletoes. The series of mountain pine beetle outbreaks, affecting virtually all host species statewide, declined somewhat in 1986. Slightly less than 870,000 acres are currently infested. In 1985, infested acres totaled nearly 940,000. Though many infestations are declining as a result of host depletion or management activities, localized infestations on parts of the Flathead, Kootenai, Deerlodge, Lolo, and Bitterroot National Forests (NF), as well as the Northern Cheyenne Indian Reservation (IR), continued to build. Adjacent private and State lands are similarly affected. Acreage of host stands on which there was aerially visible defoliation caused by western spruce budworm also declined slightly in 1986. Just over 2.5 million acres were affected this year, compared to 2.7 million acres in 1985. Most damage continued to occur on drier Douglas-fir sites on east-side Forests and adjacent lands of other ownerships.

Root diseases of several species, but primarily Armillaria root disease and yellow laminated root rot, affect an estimated 1 million acres. Most damage occurs in Douglas-fir and true fir stands west of the Continental Divide. Recent surveys indicate some stands may be experiencing as much as 4 percent root disease-related mortality annually. Dwarf mistletoes continued to cause significant growth loss and some mortality on approximately 2.5 million acres in 1986.

Smaller, but locally important infestations of Douglas-fir beetle, pine engraver, and western balsam bark beetle resulted in measurable mortality in some areas. The latter, likely in concert with root diseases, caused subalpine fir mortality on more than 4,500 acres on the Gallatin NF. Significant amounts of defoliation attributed to the larch sawfly were observed on the Thompson Falls Ranger District (RD), Lolo NF. Likewise, forest tent caterpillar caused defoliation of several hardwood species on the Flathead IR and on privately owned land in the Rattlesnake Creek, Pattee Creek, Lolo Creek, and Grant Creek drainages near Missoula. The pine needle sheathminer affected lodgepole pine stands in an area 15 miles square around and north of Columbia Falls and extending into Glacier National Park. Though infestations of this pest are usually short lived, they expanded considerably over the area observed in 1985.

Surveys established to define extent of lodgepole terminal weevil continued to show occasional significant amounts of terminal mortality in young lodgepole pine stands. One survey on the Tally Lake RD, Flathead NF, showed nearly 60 percent of the trees surveyed had been affected at some time.

Efforts to monitor potentially damaging populations of Douglas-fir tussock moth and gypsy moth through the use of pheromone-baited traps continued in 1986. Of 33 sites at which tussock moth traps were hung, only four had an average of more than 10 moths per trap. There were, however, slight increases in the number of moths trapped at several sites. Gypsy moth traps were hung in 65 campgrounds or high public-use areas in western Montana and Yellowstone National Park (NP) in 1986. In each of these three traps a male gypsy moth was caught.

INSECTS

Bark Beetles

Mountain Pine Beetle

Mountain pine beetle-caused mortality in all host species, though slightly decreased in 1986, continued to be a major concern of land managers on all ownerships (figure 1). Having returned to nearly endemic status in southwest Montana and Yellowstone NP, beetle infestations are still building in some locations in the west central and northwestern parts of the State. Affected stands under Federal jurisdiction total more than 598,000 acres of lodgepole pine, 22,300 acres of ponderosa pine, 3,000 acres of whitebark pine, and 2,200 acres of western white pine (table 1). Stands under State and private ownership showing beetle-killed trees exceed 217,000 acres of lodgepole pine, 19,900 acres of ponderosa pine, 1,200 acres of whitebark pine, and 2,000 acres of western white pine (table 2).

Beaverhead Reporting Area - The once extensive infestation in this area continued its decline in 1986. Where more than 4,000 acres of faded trees on lands of all ownerships were observed in 1985, fewer than 200 acres were noted in 1986. Though susceptible stands still exist in the Pioneer Mountains on the Wise River RD and on parts of the Wisdom RD, infestations have not yet begun to develop.

Bitterroot Reporting Area - More beetle-killed ponderosa pines were observed in 1986 than had been recorded in 1985. Affected acreage on Federal lands increased from just under 1,000 acres to more than 1,600. On State and private lands there was nearly a fivefold increase--from 660 acres to just over 3,300. No major outbreak areas were noted. Rather, mortality is scattered in 5- to 10-tree groups throughout the Bitterroot drainage and its tributaries. A growing infestation in lodgepole pine stands exists on the Forest; however, it is confined to the western portion of the West Fork RD (Frank Church River of No Return Wilderness) across the Bitterroot Divide into Idaho.

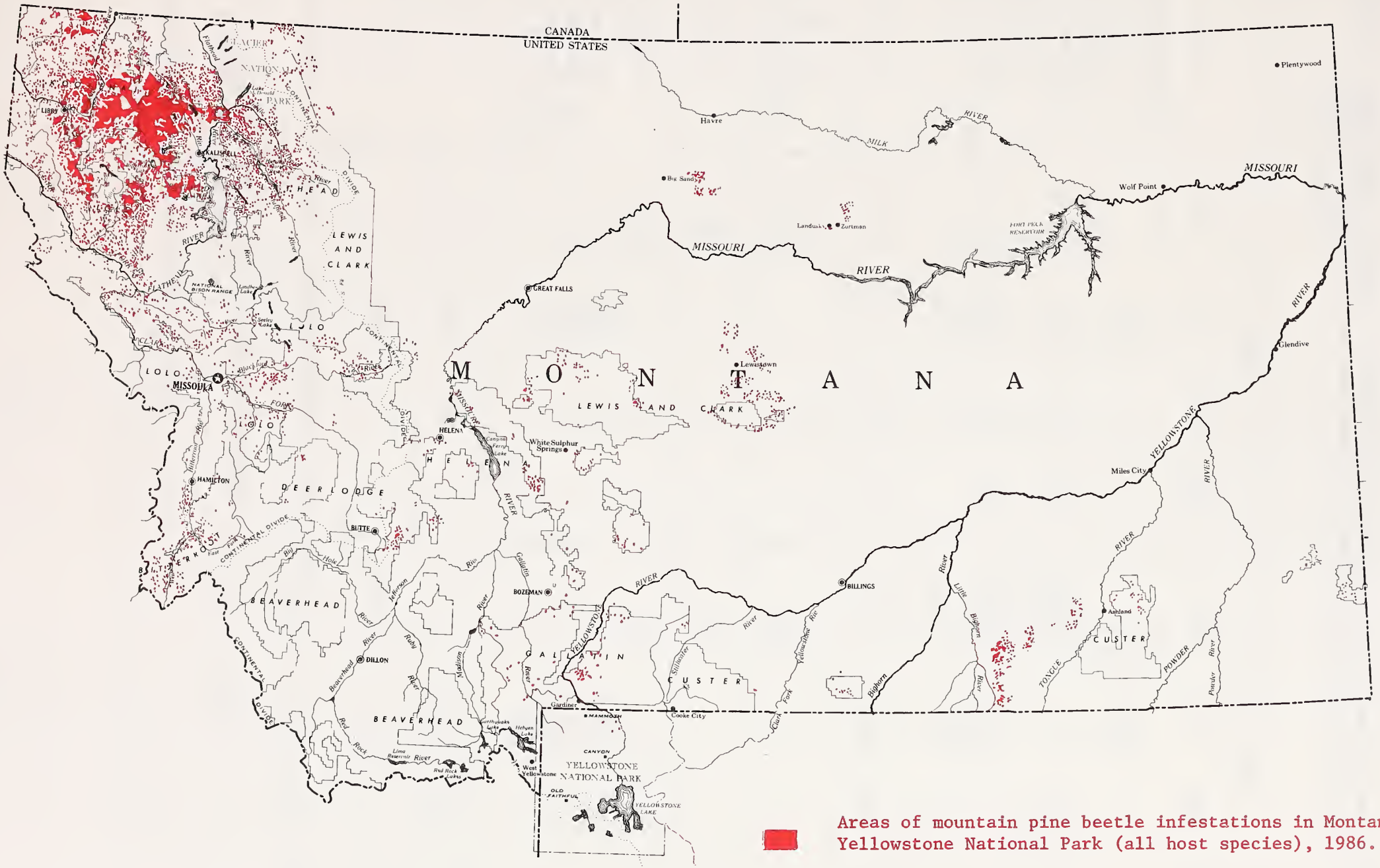

CANADA
UNITED STATES
M O N T A N A
MISSOURI RIVER
YELLOWSTONE RIVER
MILK RIVER
Havre
Plentywood
Wolf Point
Big Sandy
Landusky
Zortman
FORT PECK RESERVOIR
GREAT FALLS
Lewistown
Glendive
Miles City
Ashland
BILLINGS
HELENA
White Sulphur Springs
BUTTE
BOZEMAN
DILLON
MISSOULA
HAMILTON
KALISPELL
LIBBY
Gardiner
MAMMOTH
Cooke City
YELLOWSTONE NATIONAL PARK
West Yellowstone
LEWIS AND CLARK
DEERLODGE
BEAVERHEAD
GALLATIN
CUSTER
LOLO
FLATHEAD
GLACIER NATIONAL PARK
CONTINENTAL DIVIDE
Areas of mountain pine beetle infestations in Montana and Yellowstone National Park (all host species), 1986.

Table 1. Acres under Federal jurisdiction in Montana and Yellowstone National Park on which mountain pine beetle-caused mortality was observed--1985 and 1986.

Area	1985				1986			
	LPP[1/]	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	4,177	--	--	--	167	--	3	--
Bitterroot NF	--	955	--	--	13	1,616	--	--
Custer NF	1	215	1		5	274	150	--
Deerlodge NF	4,963	--	--	--	2,377	--	--	--
Flathead NF	124,950	3,538	2,318	1,547	209,312	62	1,246	1,054
Gallatin NF[2/]	--	--	--	--	6,481	--	578	--
Helena NF	1,342	211	48	--	2,433	937	--	--
Kootenai NF	363,398	12,326	202	970	336,555	4,710	5	631
Lewis & Clark NF	67	5,825	--	--	112	1,919		
Lolo NF	20,136	1,247	1,114	1	32,012	877	849	39
Total NF	519,034	24,317	3,683	2,518	589,467	10,395	2,831	1,724
Glacier NP	12,412	1	157	58	1,956	--	--	551
Yellowstone NP	6,885	--	44	--	310	--	--	--
Total NP	19,297	1	201	58	2,266	--	--	551
Blackfeet IR	4,188	--	10	--	704	--	--	--
Crow IR	--	5,717	--	--	--	5,301	--	--
Flathead IR	1,923	1,825	139	--	1,674	1,743	291	--
Ft. Belknap IR	--	925	--	--	--	405	--	--
N. Cheyenne IR	--	2,836	--	--	--	2,556	--	--
Rocky Boy's IR[2/]	--	--	--	--	355	593	--	--
Total IR	6,111	11,303	149	--	2,733	10,598	291	--
BLM (Total)	29	2,491	--	--	3,994	1,762	--	--
Total Federal	544,471	38,112	4,033	2,576	598,460	22,755	3,122	2,275

[1/] LPP = lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

[2/] Aerial surveys not conducted in 1985.

Table 2. **Acres of State and private ownership in Montana on which mountain pine beetle-caused mortality was observed--1985 and 1986.**

Area	1985				1986			
	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead	278	--	--	--	--	--	--	--
Bitterroot	--	666	--	--	--	3,329	--	--
Custer	5	184	110	--	1	25	272	--
Deerlodge	21	--	--	--	218	5		
Flathead	100,550	9,001	1	316	67,814	3,973	--	174
Gallatin NF[2/]	--	--	--	--	2,354	--	40	--
Garnets	374	2,948	--	--	3	1,567	--	--
Helena	189	581	--	--	280	1,008	60	--
Kootenai	191,581	8,893	60	9	77,254	3,788		230
Lewis & Clark NF	1	19,726	--	--	128	2,851	--	--
Lolo NF	10,057	714	1	--	16,101	3,110	1	1
Stillwater SF[2/]	--	--	--	--	51,212	101	885	1,617
Swan River SF[2/]	12	1	6	28	--	--	--	--
Thompson R. SF	659	173	--	--	1,961	187	--	--
Totals	303,728	42,887	178	353	217,326	19,944	1,258	2,022

[1/] LPP = lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

[2/] Aerial surveys not conducted

Custer Reporting Area - Some small increases in infested acres were noted on the Forest and adjacent State and private lands in some areas. Forestwide, however, a nearly static condition exists. Scattered mortality in ponderosa pine was observed south and east of Ashland, in the Ekalaka Hills, and in the Long Pines unit of the Sioux RD. On the Beartooth RD mortality can still be found in whitebark pine stands near Red Lodge. A few small groups of faded lodgepole pine were noted south of Big Timber.

Deerlodge Reporting Area - Though infested acres decreased by about half in 1986, several very active infestation spots remain on the Jefferson RD near Homestake Pass. In a few stands that were ground checked in that area, 1986 attacks were four times the number attacked in 1985. Approximately 2,500 acres, Forestwide on all ownerships, showed faded lodgepole pines. More than 80 percent were on the Jefferson RD. There, many susceptible stands remain and until they are brought under management, the potential for population increases exists.

Flathead Reporting Area - Forest-wide, acres showing beetle-killed trees increased substantially in 1986. Considering all host species affected on all ownerships, infested acres totaled more than 288,000--compared to 238,000 in 1985. Largest increases were noted on the Glacier View, Hungry Horse, and Tally Lake RD's. Infestations on the Glacier View and Hungry Horse RD's are confined to stands generally in the Columbia Falls/Hungry Horse vicinity. Though thousands of acres are presently infested from approximately Coal Creek on the Glacier View RD southeast to Firefighter Mountain on the Hungry Horse RD, ground data collected suggest susceptible hosts may be nearly depleted. A similar situation exists on the Tally Lake RD where infested acres of lodgepole pine increased from just under 100,000 acres to more than 173,000 in 1986. A combination of accelerated harvesting and host depletion should result in a decline of the infestation in the next year or so. Infested acres still exist on the Island Unit west of Flathead Lake. Active and progressive management strategies are helping to reduce beetle-caused impacts on the Forest.

On the Stillwater State Forest, which is adjacent to the Glacier View RD on the west, more than 53,000 acres are currently infested. That area was not flown in 1985, but that is very likely a significant increase.

More than 95 percent of the infested stands within the Flathead/Stillwater reporting areas are lodgepole pine. There are, however, significant amounts of whitebark pine, western white pine, and ponderosa pine being killed throughout the area.

Gallatin Reporting Area - The Gallatin NF was not flown in 1985, so comparative infested acres are not available. However, the once massive infestation which existed for nearly a decade on the Bozeman and Hebgen Lake RD's has now completely subsided. Only a few small and widely scattered groups of faders were observed within the Gallatin River drainage. None were noted on the Hebgen Lake RD. Approximately 8,800 acres of beetle-killed trees were mapped on lands of all ownerships within the Forest boundaries. These were mostly in lodgepole pine stands in the Gallatin and Bridger Mountains near Bozeman (Bozeman RD), the Absaroka Range south of Livingston (Livingston and Big Timber RD's), and the Crazy Mountains north of Livingston (Livingston RD).

Garnets Reporting Area - Scattered beetle-killed ponderosa pines on State, private, and BLM-administered lands declined in 1986. Most of those were confined to the Blackfoot River drainage near Potomac and Greenough. Infested acres totaled only slightly more than 1,500, whereas more than 3,000 were mapped in 1985.

Helena Reporting Area - Infested acres of both lodgepole and ponderosa pines increased in 1986. Federal, State, and privately owned lands showed similar trends. More than 2,700 acres of lodgepole pine and 1,900 acres of ponderosa pine are currently infested. Most of the active infestations are found in the Elkhorn and Big Belt Mountains south and east of Helena (Townsend RD).

Kootenai Reporting Area - The infestation on the Kootenai NF and surrounding State and private lands continued to be the most damaging in the State. On all ownerships, more than 413,000 acres of lodgepole pine, 8,500 acres of ponderosa pine, and 860 acres of western white pine are currently infested. Though active and still building populations exist in many areas on the Fisher River, Fortine, and Libby RD's, overall infested acres on the Forest have declined since 1985. The oldest infestation, on the Yaak RD, continued to decline dramatically. Other areas around Libby and on both sides of Lake Koocanusa are experiencing devastating infestations. As extensive as these infestations currently are, we believe they should continue to gradually decline over the next several years. Many stands are now being infested which are not conducive to high brood production, and many others are being brought under management. Both factors will ultimately result in substantially reduced food supplies for the beetle.

Lewis and Clark Reporting Area - A marked reduction in infested ponderosa pine stands was noted in 1986. More than 25,500 infested acres on Federal, State, and private lands were recorded in 1985. That figure is now less than 5,000 acres. Data collected during ground observations confirmed the declining trend. Surveys of seven ponderosa pine stands showed that an average of 34 trees per acre were killed in 1985, whereas only 6 trees per acre were killed in 1986. Most ponderosa pine damage is found north of Lewistown in the Judith Mountains and south of there in the Snowy Mountains. Lodgepole pine faders were observed on 2,240 acres--a slight increase over 1985. Mortality is concentrated in the Castle Mountains.

Lolo Reporting Area - Substantial increases in infested acres were recorded in 1986. Acres of lodgepole pine on all ownerships increased from just over 30,000 to more than 48,500. Most of those infested areas are still in the Thompson River drainage and the adjacent Thompson River State Forest, which showed more than 1,900 acres of infested lodgepole pine--a marked increase over 1985. Increases were noted on the Ninemile RD as well. Ponderosa pine mortality was observed on another 3,700 acres, most of which is scattered in small groups throughout the Clark Fork, Blackfoot, and Thompson River drainages.

Glacier National Park - The infestations in Glacier NP continued to decline. Lodgepole pine mortality was observed on less than 2,000 acres. Another 500 acres of beetle-killed western white pine were recorded. The only area of current beetle activity in the Park is in the southern portion along the Middle Fork of the Flathead River, east of McDonald Lake, which is part of the generally increasing area near Columbia Falls and Hungry Horse.

Yellowstone National Park - The infestation in Yellowstone NP has virtually died out. A few small groups of lodgepole pines killed by the beetle, totaling just over 300 acres, were observed near Tower Creek Campground. Small amounts of beetle-killed limber pine were noted near Mammoth.

Blackfeet Indian Reservation - As was noted for Glacier NP, the associated infestations on the Blackfeet IR continued to decline in 1986. Lodgepole pine faders were recorded on just over 700 acres. Ground surveys indicated a further declining trend due to what apparently was extensive mortality of overwintering beetle broods during the winter of 1985-86. Susceptible lodgepole pine stands remain, but the beetles are expected to stay at low population levels for the next few years.

Crow Indian Reservation - This infestation remained static in 1986. Just over 5,700 acres were infested in 1985; 5,300 acres were recorded in 1986. The infestation, located in the Wolf Mountains on the eastern portion of the Reservation, is expected to continue at about the same level into 1987.

Flathead Indian Reservation - The infestations on the Flathead IR also remained at approximately the same level in 1986. A slight decrease in lodgepole pine acres infested--from 1,900 to 1,600--was recorded. A similar small decline in ponderosa pine stands was noted--from 1,800 acres to 1,700 acres. Lodgepole pine mortality is located mostly in the northwest corner of the Reservation. Ponderosa pine mortality is scattered but is especially prevalent in the area known as Hog Heaven.

Fort Belknap Indian Reservation - Some ponderosa pine mortality was observed on the Reservation and adjacent BLM lands northeast of Zortman. The infested area declined in 1986, however, from 925 acres to just over 400 acres.

Northern Cheyenne Indian Reservation - Reservation-wide, ponderosa pine mortality decreased only slightly in 1986--from 2,800 acres to about 2,500 acres. The infested area east of Lame Deer declined while infested stands south of Busby along the Rosebud River increased notably. Ground surveys conducted there showed a nearly 2 to 1 buildup in infested trees from 1985 to 1986.

Rocky Boy's Indian Reservation - While surveys were not conducted in 1985, 1986 aerial surveys recorded almost 600 acres of infested ponderosa pine and another 350 acres of lodgepole pine mortality. Most infested stands are south of Rocky Boy's Agency in Big Sandy and Muddy Creek drainges.

Mountain Pine Beetle Associated Activities in 1986 - In cooperation with personnel from Pacific Southwest Forest and Range Experiment Station, we once again tested pine oil and three separate fractions of pine oil as preventive treatments to protect lodgepole pine from attack by mountain pine beetles. The test, conducted on Tally Lake RD (Flathead NF), compared Norpine 65P, "M+P," "Poly M+P," and "Poly M" for protective qualities. Twenty-one trees were treated with each of the four chemicals. Twenty-one "controls" received no treatment. Following beetle flight, treatments were assessed. Though data analysis is not yet conmplete, preliminary results indicated the following percent of the treated trees were successfully protected:

Norpine 65 - 74 percent
M+P - 44 percent
Poly M+P - 55 percent
Poly M - 82 percent
Control - 69 percent of controls were killed.

Results of studies begun in 1979 on the Lolo and Kootenai NF's to demonstrate effectiveness of reducing stand susceptibility to mountain pine beetles through partial cutting have led to the operational use of that strategy. Cuts of that type were established in lodgepole pine stands on the Swan RD (Flathead NF) and in mixed ponderosa/lodgepole pine stands on the Fisher River RD (Kootenai NF). These stands are to be monitored closely to determine long-term treatment effectiveness. Similar areas have been identified on the Crow and Northern Cheyenne IR's in second-growth ponderosa pine stands. Those units have not yet been cut.

Douglas-fir Beetle

Douglas-fir beetle infestations, often found in conjunction with root disease, defoliation, or some other stand-disturbing agent, were recorded in mostly small, scattered groups in various parts of the State. Statewide, only about 2,200 acres of infested Douglas-fir stands were observed (table 3). Slightly more than 600 acres were recorded on the Flathead NF, but no large infested areas are known. Rather, they are scattered throughout areas of host type. Several groups were noted in the Coram Experimental Forest (Hungry Horse RD). More than 500 acres were observed on the Bitterroot NF, but they too are widely scattered. No major population buildups are anticipated in 1987.

Spruce Beetle

Spruce beetle, like Douglas-fir beetle, is currently found only in very small, widely scattered groups. Most are concentrated in high-elevation, nearly inaccessible stands in spruce-fir forest types. A dramatic decrease in the number of infested acres has occurred since surveys were conducted in 1985. Last year, more than 4,400 acres--most on the Flathead NF--were recorded. In 1986, only 133 acres were noted statewide (table 3). The large infestations affecting many spruce stands in the northwest part of the State only a few years ago have been reduced to endemic status.

Western Balsam Bark Beetle

Subalpine fir mortality attributed to western balsam bark beetle more than doubled from 1984 to 1986. However, no aerial surveys were made on the Gallatin NF in 1985. More than 4,500 of the 5,600 acres observed in 1986 were on the Gallatin NF. Approximately 500 acres were noted on the Flathead NF. Though some groups as large as 500 trees--covering 600 to 700 acres--were observed, most mortality was found in smaller groups of 10 to 100 trees. While subalpine fir mortality is often significant, it is likely the western balsam bark beetle is only the most obvious factor in a complex of insect and disease agents affecting those stands.

Pine Engraver

Ponderosa pine mortality attributed to the pine engraver was recorded on 224 acres on the Custer NF and another 256 acres on the Flathead IR. Very little was noted elsewhere in the State. Pine engraver populations are dependent upon either some type of stand disturbance which creates colonization sites in downed material, or extremely dry weather which promotes buildup in standing

trees. These conditions can occur at varying times of the year so aerial survey estimates do not always accurately reflect actual damage levels. That was the case in 1985 when damage was noted in western Montana after aerial survey flights were conducted. To our knowledge, no areas of significant mortality now exist except those noted.

Table 3. Acres on which bark beetle-caused mortality (other than mountain pine beetle) was observed in Montana and Yellowstone National Park--1986.

Area	Douglas-fir Beetle		Spruce Beetle		Pine Engraver		Western Balsam Bark Beetle	
	Federal	State & private	Federal	State & private	Federal	State & private	Federal	State & private
Beaverhead	157	1	--	--	--	--	303	3
Bitterroot	577	6	35	--	1	--	11	--
Custer	--	6	--	--	224	5	--	160
Deerlodge	1	--	--	--	--	--	162	--
Flathead	612	--	92		--	--	493	--
Gallatin	200	--	--	--	--	--	4,528	352
Garnets	--	18	--	--	--	--		
Helena	--	12	--	--	--	--	--	--
Kootenai	--	--	1	--	--	10	22	--
Lewis & Clark	--	--	--	--	--	--	26	--
Lolo	312	36	--	--	2	1	31	2
Glacier NP	3	--	4	--	--	--	--	--
Yellowstone NP	--	--	--	--	--	--	--	--
Blackfeet IR	--	--	--	--	--	--	51	--
Crow IR	--	--	--	--	--	--	--	--
Flathead IR	271	--			256	--	7	--
Ft. Belknap IR	--	--	--	--	--	--	--	--
N. Cheyenne IR	--	--	--	--	--	--	--	--
Rocky Boy's IR	1	--	--	--	--	--	1	--
BLM (Total)	14	--	--	--	--	--	3	--
Stillwater SF	--	--	--	--	--	--	2	--
Thompson R. SF	--	2	--	--	--	--	1	--
Total	2,148	81	132	--	483	16	5,641	517

Red Turpentine Beetle

Red turpentine beetle outbreaks are uncommon even though endemic populations of the beetle can be found in many ponderosa pine stands. Populations can build to damaging proportions following fire, harvesting activities, or drought conditions. On the Fort Belknap IR, beetle broods developed in slash following a thinning operation, and subsequent flights began attacking leave trees. Few trees were attacked sufficiently to cause their death, but brood development could have weakened the trees to the point that they may have been killed by other, more aggressive insect species. An insecticidal control program was recommended and should reduce populations to insignificant levels.

Defoliators

Western Spruce Budworm

The series of western spruce budworm outbreaks, evident on many of the drier Douglas-fir sites in the State for nearly 40 years, continued virtually unabated in 1986 (figure 2). Down only slightly statewide, visible defoliation was observed on more than 2.5 million acres, compared to 2.7 million acres in 1985 (table 4). While some areas, notably the Beaverhead, Custer, Gallatin, and Lewis & Clark NF's, and Flathead and Crow IR reporting areas, showed marked decreases in defoliated acres, others--Bitterroot, Deerlodge, Helena, and Lolo NF reporting areas--experienced significant increases. According to impact survey results, growth loss in defoliated areas approximates 7 cubic feet per acre per year. Defoliation of the magnitude recorded in 1986 represents a loss of 17.5 million cubic feet of tree growth. In many of those infested areas, a more dramatic, and very real, loss is in seed production and resultant reproductive potential.

On the Big Timber RD, Gallatin NF, heavily infested Douglas-fir on 700 acres was treated with *Bacillus thuringiensis* (*B.t.*) in an effort to reduce budworm populations prior to a scheduled seed tree harvest in 3 years. The stand will be treated for the 3 consecutive years prior to cutting in hopes of maintaining tree vigor sufficient to produce a cone crop. The year following harvest, as the site is being prepared for natural regeneration, selected trees will be treated with acephate implants to protect developing cones.

Acephate implants are now being used operationally to protect cones. Such treatments were successfully completed on both the Gallatin and Deerlodge NF's in 1986.

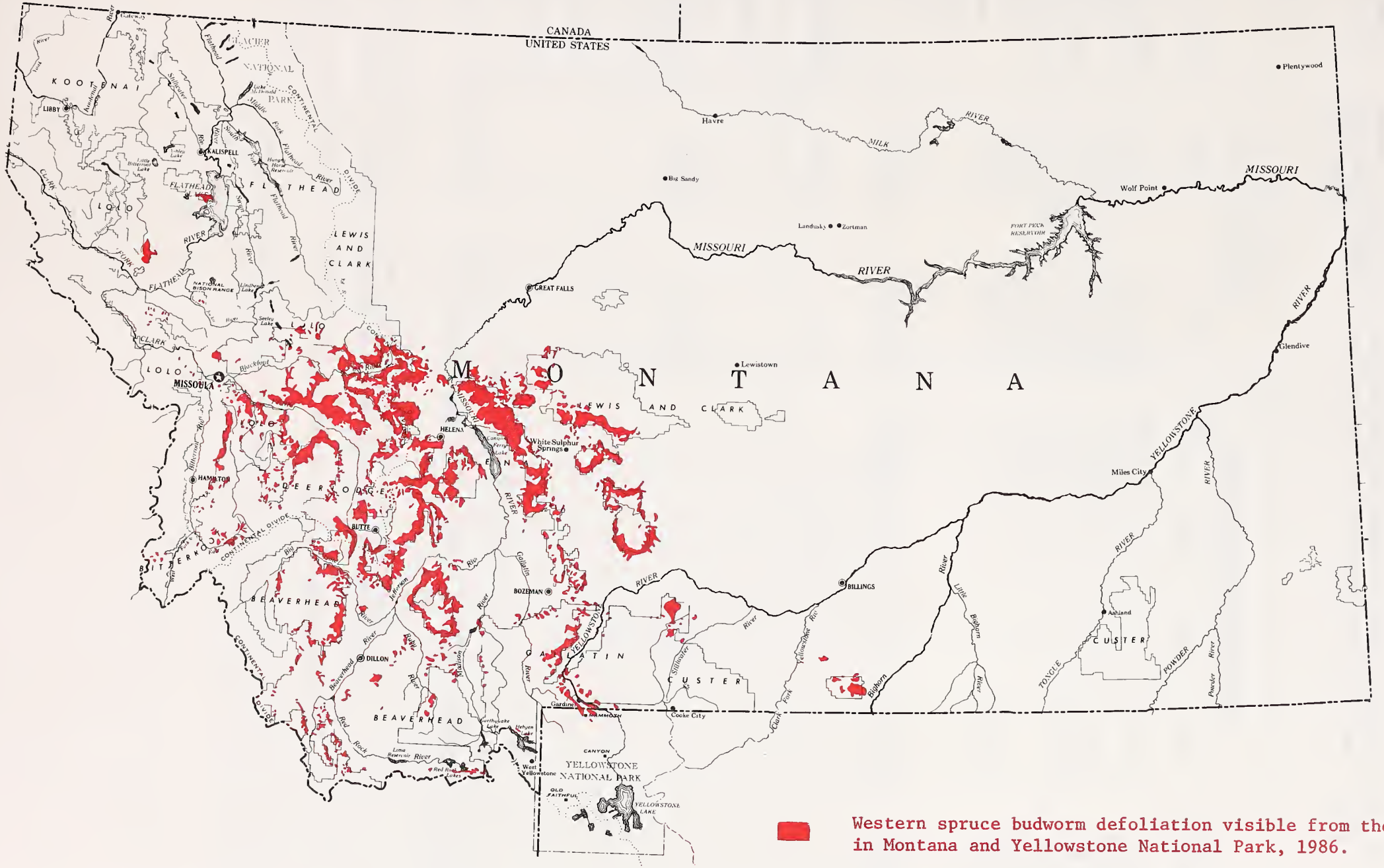

CANADA
UNITED STATES
MONTANA
Western spruce budworm defoliation visible from the air in Montana and Yellowstone National Park, 1986.

Table 4. Acres of aerially visible western spruce budworm defoliation, on all ownerships, in Montana and Yellowstone National Park, 1985 and 1986.

Area	Total acres all ownerships		1986 acres by ownership				
	1985	1986	NFS[1]	NPS	BIA	BLM	State & private
Beaverhead	337,157	318,194	180,973	--	--	77,222	59,999
Bitterroot	25,106	60,149	31,372	--	--	--	28,777
Custer	90,550	29,388	6,858	--	--	2,213	20,317
Deerlodge	326,375	501,854	262,934	--	--	60,305	178,615
Flathead	6,295[2]	6,616	1,150	--	--	--	5,466
Gallatin	425,240[2]	276,315	123,803	--	--	--	152,512
Garnets	185,347	199,350	--	--	--	43,236	156,114
Helena	757,039	826,265	447,618	--	--	43,011	335,636
Kootenai	--	--	--	--	--	--	--
Lewis & Clark	281,111	174,056	109,625	--	--	1,370	63,061
Lolo	40,664	85,511	53,232	--	--	50	32,229
			--	--	--	--	--
Glacier NP	--	--	--	--	--	--	--
Yellowstone NP	29,155	7,834	--	7,834	--	--	--
Blackfeet IR	--	--	--	--	--	--	--
Crow IR	15,445	4,260	--	--	4,260	--	--
Flathead IR	35,329	14,569	--	--	14,569	--	--
Ft. Belknap IR	--	--	--	--	--	--	--
N. Cheyenne IR	--	--	--	--	--	--	--
Rocky Boy's IR	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
Totals	2,554,813	2,504,361	1,217,565	7,834	18,829	227,407	1,032,726

[1]NFS = National Forest System; NPS = National Park Service; BIA = Bureau of Indian Affairs; BLM = Bureau of Land Management

[2]Gallatin NF not flown in 1985. Figure shown is calculated from 1984 and 1986 data.

Douglas-fir Tussock Moth

Douglas-fir tussock moth populations remained at endemic levels at all 33 sites surveyed in 1986. Pheromone traps used to monitor adult male population levels showed slight increases over 1985, but only four of those sites had average moth counts exceeding 10 moths per trap. An average of 25 moths per trap has been established as the point beyond which populations are considered to be high enough to cause concern. Two sites are close to 25 moths per trap, two closer to 20, the remaining 29 fewer than 10 (table 5).

Tussock moth populations in the Palouse region of northern Idaho apparently peaked at high, but lower than anticipated, levels in 1985. In 1986, populations began to decline despite visible defoliation being evident in some locations. Corresponding population rises did not occur in western Montana. Trapping sites will be monitored again in 1987 to ascertain any population fluctuations that may occur.

Table 5. Douglas-fir tussock moth trap catches[1] in western Montana, 1985-1986.

Plot	1985	1986	Plot	1985	1986
Albert Creek	0	0.8	Lakeside	0.4	3.8
Arlee	0.4	2.8	Lolo Creek	0	0.6
Big Arm	0	1.0	Pattee Canyon	0.2	1.6
Big Fork	1.0	0	Petty Creek	0.2	5.0
Blue Mountain	1.0	7.6	Pistol Creek	27.8	20.2
Butler Creek	1.4	4.6	Polson-Big Creek	0	4.2
Clear Creek	0.8	7.2	Polson-Hellroaring	0	0
Corral Creek	1.4	6.0	Polson-Lost Lake	0	1.4
Ferndale	0	0	Revias Creek	0.6	1.6
Fish Creek	0.6	2.4	Rocky Point	0	0.4
Foys Lake	0.2	0.2	St. Mary Lake	0.2	3.0
Frenchtown F	0.2	6.2	Skidoo Bay	0	0
Frenchtown J	2.4	23.6	Smith Camp	0.2	2.0
Frenchtown T	0	4.0	Somers #1	20.2	24.6
Jette Lake	0.2	5.8	Somers #2	1.0	8.0
Kerr Dam	1.0	17.2	Worden Creek	0.4	0.8
Lake Mary Ronan	0.2	1.2			

[1]Average number male moths caught in five traps per site.

Gypsy Moth

The potential for gypsy moth outbreaks in Montana continues to be of concern to resource and pest managers. Moth populations do not naturally migrate to much extent because of the essentially flightless female. However, populations in the pupal or egg stage have been transported great distances by "hitching rides" from infested areas to noninfested ones. Pheromone traps are deployed to detect new infestations so control measures, if needed, can be conducted while populations are still small enough to be manageable.

Personnel from CFPM and Montana Department of State Lands directed the deployment of 315 traps in 65 campgrounds or public use areas in Montana and Yellowstone NP. One male moth was caught at each of three separate locations--one in Yellowstone NP; one near Evaro, north of Missoula, and one a few miles west of Bozeman. Though single moth catches do not necessarily represent building populations, they do indicate moths are being transported into the State. All sites will be monitored again in 1987.

Pine Needle Sheathminer

Defoliation caused by the sheathminer increased significantly in lodgepole pine stands in a large area centered approximately on Columbia Falls. In an area roughly 15 miles square--which included parts of the Hungry Horse and Glacier View RD's (Flathead NF), Glacier NP, and much State and private land--damage was variable but heavy in many stands. Damage was also evident in ponderosa pine stands throughout the Flathead Valley, and in the eastern part of the State on the Custer NF. Sheathminer populations generally have not persisted in a particular area for more than a few years. Trees are not usually killed outright, but persistent infestations result in growth loss and may predispose them to other more damaging agents (figure 3).

Figure 3.--Damage to lodgepole pine. caused by pine needle sheathminer

Forest Tent Caterpillar

For the second year in succession, the forest tent caterpillar defoliated hardwood trees and brush species in the southern portion of the Flathead IR and the Rattlesnake Creek, Grant Creek, Pattee Creek, and Lolo Creek drainages near Missoula. Affecting mostly birches, willows, and cottonwoods in portions of the Mission Valley, caterpillars defoliated a large area north of St. Ignatius. Ornamentals and fruit trees were also affected in Missoula (figure 4). Infestations are usually short-lived, but the break will be monitored closely to determine if control measures are warranted.

Figure 4.--Forest tent caterpillar larva.

Miscellaneous Insects

Lodgepole Terminal Weevil

Efforts to determine the extent of lodgepole terminal weevil damage in lodgepole pine regeneration continued for a third year. In 1986, stands on the Tally Lake RD (Flathead NF) were surveyed. In the stands sampled, current terminal mortality ranged from 1 to 11 percent. Nearly 60 percent of the trees, however, had been attacked at some time. Stands sampled previously in other parts of the State showed as many as 80 percent of the trees affected. Total effects on stands throughout a rotation have not been determined.

Western Pine Shoot Borer

This pest of ponderosa pine, and occasionally lodgepole pine, plantations can be found throughout the State. Though terminal shoots are not often killed, height growth is sufficiently reduced that overall volume loss per tree over a rotation is significant. This growth reduction can be especially troublesome in test plantations where height growth of several "families" is compared for genetic superiority. Testing has shown that mating disruption through the use of pheromone-impregnated plastic strips can reduce populations to endemic levels. Two progeny test plantations are currently being treated--a Forest Service plantation at Condon and a State plantation at Lubrecht. Treatments over the past 3 years have reduced infestation rates from more than 20 percent to less than 5 percent. Treatments will continue for 4 additional years, until the next height growth measurements are made.

Western Pine Tip Moth

In 1985, top killing in ponderosa pine stands was recorded on more than 66,000 acres within the Ekalaka Hills and Long Pines unit, Sioux RD (Custer NF). Though damage was once again evident in 1986, it did not appear to be heavy. That population is apparently declining.

DISEASES

Root diseases, dwarf mistletoes, stem rusts, and heartrots are the most damaging forest diseases in Montana. Generally, root diseases are most common west of the Continental Divide. Diseases fluctuate little and inflict heavy tolls on Montana's forests. Some diseases are important to certain types of industries; for example, needle casts affect Christmas tree production. Disease management is a critical part of forest management. Actions taken now on behalf of disease management will largely determine future productivity of Montana's forests.

Root Diseases

Armillaria root rot, laminated root rot, Schweinitzii root and butt rot, and annosus root rot are our most important root diseases. All are capable of being locally limiting to timber production. Schweinitzii root and butt rot also creates problems in developed recreation areas where weakened trees are prone to fail and cause injury.

Armillaria root rot is Montana's most important root disease. Armillaria kills trees of all ages. It is most common and damaging on our most productive sites. It is made more severe through our normal management practices; that is,harvesting trees. The fungus lives in the root systems of dead trees where it develops increasing potential to infect adjacent trees--including seedlings planted to regenerate harvested sites.

Damage by Armillaria root rot is greatest on the Lolo and Kootenai NF's, the Flathead IR, and in localized concentrations on the Flathead, Lewis and Clark, and Helena NF's. It is also found in many stands in other forests, including tracts of private forest land.

Laminated root rot is not as prevalent in Montana as is Armillaria. It is generally limited to the range of grand fir in the State. Where it occurs, however, it is very damaging. The Lolo and Kootenai NF's and adjacent private lands have the most severe infestations.

Douglas-fir has long been our most widely planted tree species. It is also the most susceptible species to both Armillaria and laminated root rots. Results from a recent study on the Lolo NF in the Crow Creek drainage indicate that Douglas-fir may be nearly twice as susceptible to death by root disease as grand fir or subalpine fir. Grand fir and subalpine fir are, in turn, about 20 times more susceptible than are western larch, ponderosa pine, or lodgepole pine (figure 5).

Losses to root disease can render stands unproductive not only for the current generation but for future generations as well. Root disease mortality has been monitored in a stand on the Flathead IR for 7 years following commercial thinning. In just 7 years the 53-year-old Douglas-fir stand has lost 23 percent of its trees greater than 5 inches in diameter (figure 6). The average diameter of trees in the stand is 11.7 inches; the average diameter of trees which have died in the stand is 11.9 inches. In 1986, an additional 21 percent of the live trees were in a sufficiently advanced stage of disease to have obvious symptoms. This means that 44 percent of the trees left just 7 years after thinning are dead or obviously dying. Few trees can be expected to reach the projected rotation age of 90 years if this rate of mortality, averaging 3.4 percent per year, continues. This rate of mortality is common for root disease-infested stands. In fact, a study on the Idaho Panhandle NF's has indicated that mortality rates of Douglas-fir have averaged 3.3 percent per year over a 6,000-acre compartment with root disease scattered throughout.

Completion of a study in a root disease pocket on forest land owned by Champion Corporation lends insight into the relative productivity of land within a root disease pocket. The infested area is about 62 acres in size. Board foot volume was compared between the root disease pocket and the uninfested portion of the stand surrounding the pocket. The pocket had produced only 20 percent of the volume produced in the 170-year-old surrounding intact stand. The stand in the disease-infested pocket had reached an equilibrium between regeneration and death--the volume within the pocket is likely to be the same in 100 years as it is today if nothing is done to break the cycle.

This summarizes some of our most recent findings regarding root disease behavior and impact. Studies are continuing to provide many more important answers to help forest managers handle root disease problems.

Figure 5.--Total and Symptomatic Basal Area per Acre by Tree Species

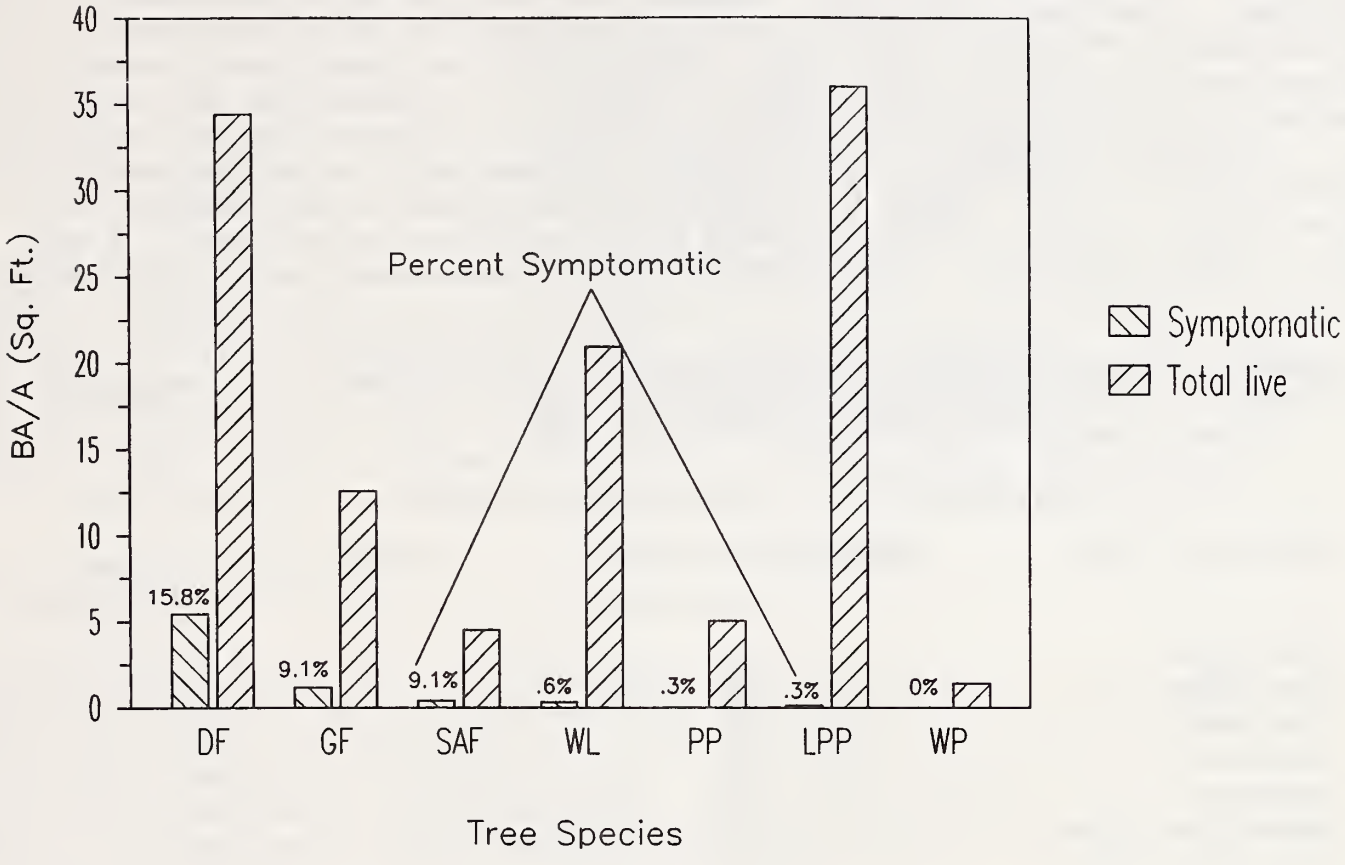
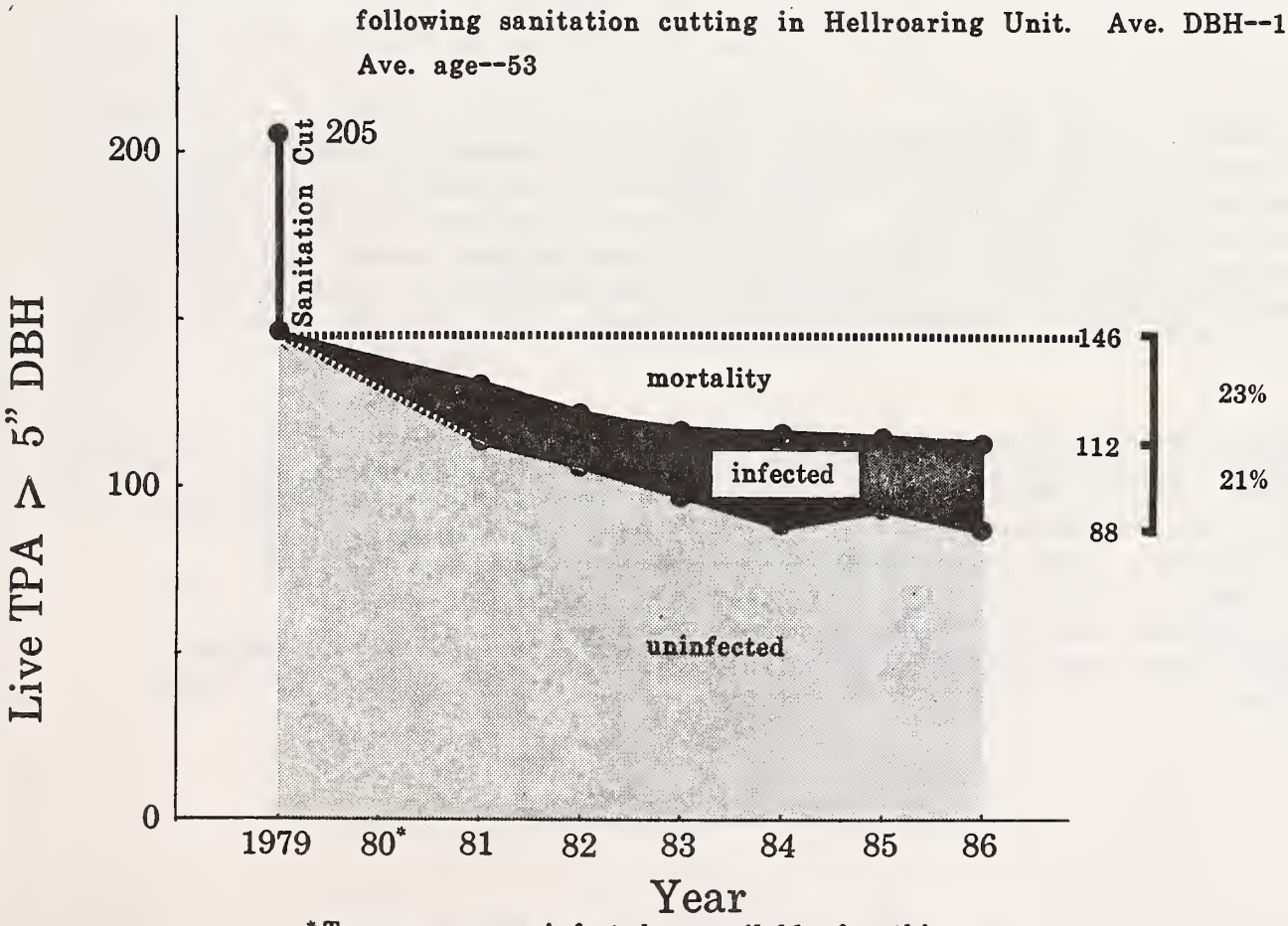


Figure 6. Live, infected and live, apparently uninfected trees per acre by year following sanitation cutting in Hellroaring Unit. Ave. DBH--11.7 in., Ave. age--53



*Trees per acre infected unavailable for this year.

Dwarf Mistletoe

The second most damaging class of diseases in Montana is dwarf mistletoe infection. These seed-producing plants have managed to infest about 2.4 million acres of Montana forest land. Douglas-fir dwarf mistletoe, which probably inflicts the greatest damage on its host, is limited to the Douglas-fir stands west of the Continental Divide. Serious infestations on the Lolo, Bitterroot, Flathead, Lewis and Clark, Helena, and Gallatin NF's and Flathead IR are being treated on a stand-by-stand basis, where possible, to reduce chronic losses. Dwarf mistletoe suppression was carried out on 1,088 acres in 1986 (table 6). Presuppression surveys were conducted on 3,260 acres.

Table 6. Area in acres on which dwarf mistletoe projects were completed in Montana National Forests in 1986.

National Forest	Suppression project	Presuppression project
Bitterroot	301	0
Deerlodge	150	0
Flathead	80	0
Gallatin	160	0
Helena	17	0
Lewis and Clark	40	0
Lolo	340	3,260
Total	1,088	3,260

A computerized model of the development and spread of lodgepole pine dwarf mistletoe has been developed using, in part, data from permanent plots in dwarf mistletoe infested stands in Montana. This is being interfaced with the Stand Prognosis Model in the Northern Region for use in predicting future impact of dwarf mistletoe on stand growth, productivity, and composition. It will assist managers in making decisions regarding control efforts.

Stem Cankers

The most aggressive of the stem canker-causing fungi is white pine blister rust. In Montana, western white pine and whitebark pine are killed. Western white pine stands on the Kootenai, Lolo, and Flathead NF's are seriously damaged by the disease. Rust resistant planting stock continues to be in short supply at this time, but this situation is improving yearly with more seed-producing orchards coming into production. Efforts continue to increase the genetic base of our resistant stock by selecting and testing new candidates for seed orchards.

Whitebark pine stands are receiving greater attention in recent years with concern over grizzly bear habitat in the Yellowstone Park area and on the Flathead NF adjacent to Glacier NP. Whitebark pine seeds are considered an important food source for bears on some sites. The impact of rust on whitebark pine is notably less than that on western white pine overall; however, some sites do pose great hazard to whitebark pine. The fungus appears to be limited by environmental conditions on most sites. Those sites on which the fungus is able to build up may not support many whitebark pines without effective controls for the disease. The disease needs to be evaluated on a site-by-site basis to determine the potential for stand-limiting damage.

Comandra blister rust is a serious disease in lodgepole pine and ponderosa pine stands. Ponderosa pines are most damaged at a young age--as seedlings and saplings. Stands of ponderosa pine with particularly high levels of damage are scattered over much of Montana. Comandra blister rust infections in lodgepole pine are serious in all sizes of trees, but distribution of the most damaged stands is more limited. Timber production is often severely impaired by comandra blister rust in lodgepole pine stands on the Beaverhead NF.

Diplodia Blight

Diplodia blight causes death of new shoots and branches up to 1 year old. Ponderosa pine is the only species known to be extensively damaged in Montana. Trees of all sizes are infected, and it is now apparent that the disease is common and widespread in western Montana. Many large diameter yard trees have succumbed to the disease, resulting in significant dollar losses to real estate values. A particularly severe infestation continues along the west shore of Flathead Lake.

Nursery Diseases

Fusarium root disease is one of the major problems of containerized seedling production in Montana forest tree nurseries. This disease is most serious in Douglas-fir, although most conifer species are affected to some degree. Recent investigations into the epidemiology of this disease indicate that although much inoculum is seed-borne, other sources including weeds in and near greenhouses and containers may be important. Also, many seedlings which lack root disease symptoms become infected at various times throughout the growth cycle. Fungicide treatments are often ineffective, and damage most often appears toward the end of the production cycle when seedlings are stressed to stop growth and set buds.

Relatively small losses were encountered from Phoma blight during 1986. The pathogen caused mostly tip blight and dieback of pine seedlings. Affected seedlings were mostly scattered.

ABIOTIC DAMAGE

Spring Freeze

A swing in early spring temperatures from 60's and 70's to subzero in some areas resulted in spectacular damage in numerous species of conifers across the State. East of the Divide ponderosa pine suffered severe defoliation from needles killed by the freeze; many small trees died when buds were killed as well. West of the Divide damage was generally less severe although common. Trees with reddened needles generally recovered through the summer because the freeze had not affected most buds. Subalpine firs in a portion of the Kootenai NF near Fortine were severely damaged by the unusual weather pattern. In particular, a stand of subalpine firs being managed for Christmas trees was rendered unsalable.

COOPERATIVE TRAINING

Personnel from CFPM and Department of State Lands conduct training programs designed to assist field-going personnel and land managers in detecting, identifying, and managing forest pests. The current training program consists of two parts: basic sessions in which field identification and life cycles are emphasized, and advanced sessions in which management alternatives receive the emphasis. The basic session, designed primarily for field-oriented personnel such as stand exam crews, is valuable to both them and us, because well-trained observers greatly enhance our detection efforts. Advanced sessions are primarily for silviculturists or others involved in developing prescriptions or management plans.

In June 1986, a basic session was held in Missoula. Twenty-three people attended. In October, an advanced session was held in Kalispell at which there were 44 attendees.

DIRECTORY OF PERSONNEL

USDA Forest Service, Northern Region
Federal Building
P. O. Box 7669
Missoula, Montana 59807

Phone: (406) 329-3280
FTS: 585-3280
DG Address: R01A

John H. Thompson	Staff Director, Cooperative Forestry & Pest Management
Bob Eder	Computer Programer/Analyst
Ed Monnig	Pesticide Coordinator
Jed Dewey	Supervisory Entomologist
Wayne Bousfield	Entomologist
Larry Stipe	Entomologist
Ken Gibson	Entomologist
Sandy Gast	Entomologist (Trainee)
Bob Oakes	Biological Technician
Hubert Meyer	Biological Technician
Jim Byler	Supervisory Pathologist
Bob James	Pathologist
Sue Hagle	Pathologist
Lionel Hall	Biological Technician
Carma Gilligan	Biological/Laboratory Technician

Montana Department of State Lands
Forestry Division
2705 Spurgin Road
Missoula, Montana 59807

Phone: (406) 542-4300

Gary G. Brown	State Forester
Roger Bergmeier	Chief, Assistance Bureau
Steve Kohler	Supervisor, Forest Insect and Disease Section

COMMON AND SCIENTIFIC NAMES

Diseases

Common Name	Scientific Name
Annosus root disease	*Heterobasidion annosum* (Fr.) Bref.
Armillaria root disease	*Armillaria obscura* (Vah.:Fr.) Morrison
Atropellis canker	*Atropellis piniphila* (Weir) Lohm. & Cash
Black stain root disease	*Leptographium* spp.
Brown cubical butt rot	*Phaeolus schweinitzii* (Fr.) Pat.
Comandra rust	*Cronartium comandrae* Peck.
Damping-off	*Fusarium* sp.; *Pythium* sp.
Diplodia tip blight	*Diplodia pinea* (Desm.) Kickx.
Douglas-fir needle cast	*Rhabdocline pseudotsugae* Syd. and *R. weirii* Parker & Reid
Dwarf mistletoes	*Arceuthobium* spp.
Elytroderma needle cast	*Elytroderma deformans* (Weir) Darker
Fusarium root disease	*Fusarium oxysporum* Schlect.
Grey mold	*Botrytis cinerea* Pers. ex Fr.
Hypodermella needle blight	*Hypodermella laricis* Tub.
Laminated root rot	*Phellinus weirii* (Murr.) Gilb.
Western gall rust	*Endocronartium harknessii* (Moore) Hirat.
White pine blister rust	*Cronartium ribicola* Fisch.

Insects

Douglas-fir beetle	*Dendroctonus pseudotsugae* Hopkins
Douglas-fir tussock moth	*Orgyia pseudotsugata* (McDunnough)
Forest tent caterpillar	*Malacosoma disstria* Hubner
Gypsy moth	*Lymantria dispar* (Linnaeus)
Lodgepole terminal weevil	*Pissodes terminalis* Hopping
Mountain pine beetle	*Dendroctonus ponderosae* Hopkins
Pine engraver	*Ips pini* (Say)
Pine needle sheathminer	*Zelleria haimbachi* Busck
Red turpentine beetle	*Dendroctonus valens* LeConte
Spruce beetle	*Dendroctonus ruifpennis* (Kirby)
Western balsam bark beetle	*Dryocoetes confusus* Swaine
Western pine shoot borer	*Eucosma sonomana* Kearfott
Western pine tip moth	*Rhyacionia bushnelli* (Busck)
Western spruce budworm	*Choristoneura occidentalis* Freeman

RECENT PUBLICATIONS

Bollenbacher, B., and K. E. Gibson. 1986. Mountain pine beetle: A land manager's perspective. CFPM Report 86-15. USDA Forest Service, Northern Region. 5p.

Bousfield, W. E.; N. W. Wulf, and L. E. Stipe. 1986. Progress report on the spruce budworm silvicultural demonstration project on the Gallatin and Lolo National Forests. CFPM Report 86-5. USDA Forest Service, Northern Region. 8p.

Bousfield, W. E., N. W. Wulf, and C. E. Carlson. 1986. Rating susceptibility of stands to western spruce budworm: users guide and documentation to SBW-hazard. CFPM Report 86-7. USDA Forest Service, Northern Region. 22p.

Bousfield, W. E., and R. L. Livingston. 1986. Application of predictive model to forecast Douglas-fir tussock moth defoliation. CFPM Report 86-10. USDA Forest Service, Northern Region. 8p.

Byler, J. W., W. E. Bousfield, and S. Kohler. 1986. Montana forest pest conditions and program highlights - 1985. CFPM Report 86-2. USDA Forest Service, Northern Region. 19p.

Byler, J. W., M. A. Marsden, and S. K. Hagle. 1987. Opportunities to evaluate root disease incidence and damage using forest inventory and permanent growth plots. Proceedings of the 34th Western International Forest Disease Workshop; Sept. 9-12, Juneau, Alaska. 5pp.

Cooperative Forestry & Pest Management; Planning, Programming, & Budgeting; and Timber Management in cooperation with the Lolo and Gallatin National Forests. 1986. Western spruce budworm in the Northern Region - 1985 situation analysis. CFPM Report 86-12. USDA Forest Service, Northern Region. 42p.

Dooling, O. J., R. R. Johnson, and R. G. Eder. 1986. Growth, impact, spread, and intensification of dwarf mistletoe in Douglas-fir and lodgepole pine in Montana. CFPM Report 86-6. USDA Forest Service, Northern Region. 11p.

Fuller, L. R. and R. L. James. 1986. Armillaria root rot. In: Riffle, J. W. and G. W. Peterson (tech. coords.). 1986. Diseases of trees in the Great Plains. USDA Forest Service, Rocky Mtn. Res. Sta. Gen. Tech. Rept. RM-129. pp. 108-109.

Hagle, S. K. and D. J. Goheen. 1986. Root disease responds to stand culture. In: Future forests of the mountain west: A stand culture symposium. Sept. 28-Oct. 1, Missoula, Montana. 6p.

Hagle, S. K. and W. A. Kissinger. 1986. Needlecasts of Scots pine Christmas trees in western Montana. CFPM Report 86-14. USDA Forest Service, Northern Region. 12p.

James, R. L. 1986. Diseases of conifer seedlings caused by seed-borne Fusarium species. In: Shearer, R. C. (Compiler). Proceedings--Conifer tree seed in the Inland Mountain West symposium. USDA Forest Service, Intermtn. Res. Sta. Gen. Tech. Rept. INT-203. pp. 267-271.

James, R. L. 1986. Occurrence of Fusarium on Douglas-fir seed and containerized seedlings at the Plum Creek Nursery, Pablo, Montana. CFPM Report 86-4. USDA Forest Service, Northern Region; 10p.

James, R. L. and D. W. Johnson. 1986. Phyllosticta leaf spots of maple and caragana. In: Riffle, J. W. and G. W. Peterson (tech. coords.). 1986. Diseases of trees in the Great Plains. USDA Forest Service, Rocky Mtn. Res. Sta. Gen. Tech. Rept. RM-129. pp. 10-11.

James, R. L. and J. E. Watkins. 1986. Leaf spots of Nanking cherry and chokecherry. In: Riffle, J. W. and G. W. Peterson (tech. coords.). 1986. Diseases of trees in the Great Plains. USDA Forest Service, Rocky Mtn. Res. Sta. Gen. Tech. Rept. RM-129. pp. 22-23.

James, R. L., E. P. Militante, J. Y. Woo, and C. J. Gilligan. 1986. Pathogenicity of Fusarium from forest seedling nurseries on Douglas-fir and ponderosa pine seedlings. CFPM Report 86-8. USDA Forest Service, Northern Region. 12p.

James, R. L., and C. J. Gilligan. 1986. Root diseases of western white pine transplants at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. CFPM Report 86-11. USDA Forest Service, Northern Region. 8p.

James, R. L. 1986. Mortality of containerized western larch seedlings at the Champion Timberlands Nursery, Plains, Montana. CFPM Report 86-16. USDA Forest Service, Northern Region. 7p.

Krupinsky, J. M. and R. L. James. 1986. Dothiorella wilt of elm. In: Riffle, J. W. and G. W. Peterson (tech. coords). 1986. Diseases of trees in the Great Plains. USDA Forest Service, Rocky Mtn. Res. Sta. Gen. Tech. Rept. RM-129. pp. 94-95.

Reedy, T., R. Becker, O. Dooling, and J. Byler. 1986. A dwarf mistletoe program for the Flathead Indian Reservation, Montana. CFPM Report 86-3. USDA Forest Service, Northern Region. 8p.

Schwandt, J. W., R. L. Livingston, D. P. Beckman, R. L. James, S. Tunnock, and K. S. Knapp. 1986. Idaho forest pest conditions and program summary - 1985. CFPM Report 86-1. USDA Forest Service, Northern Region. 31 p.

Stipe, L. E. and K. E. Gibson. Progress report: 1986. A pilot project to evaluate efficacy of aerially applied nucleopolyhedrosis virus on Douglas-fir tussock moth in northern Idaho - 1985. CFPM Report 86-13. USDA Forest Service, Northern Region. 12p.

Tunnock, S., M. D. McGregor, R. D. Oakes, and H. E. Meyer. 1986. Mountain pine beetle infestations in the Northern Region during 1985. CFPM Report 86-9. Missoula, MT: USDA Forest Service, Northern Region. 11p.